

Seneca Glass Company
Beechurst Ave. between 6th & 8th Sts.
Morgantown
Monongalia County
West Virginia

HAER WV-6

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD

SENECA GLASS COMPANY

WV-6

Location:	Morgantown, West Virginia
Date of Construction:	1896
Significance:	The plant is of technological interest, as it uses the same machinery and process with which it began over 80 years ago. Economically the plant is of interest because it was the first of many companies to locate in Morgantown. Since the founders were of German origin, Seneca's history sheds light on the position of immigrant labor in the glass industry.
Current Condition:	Original machinery still operating
Present Use:	Glass factory
Historian:	Dennis Zembala
Transmitted by:	Daniel Clement, 1984

SENECA GLASS COMPANY

INTRODUCTION

Seneca Glass Company was founded by a group of immigrant German glassblowers. Natives of the district of Baden in southern Germany, many of these men had previously been employed at the North Cumberland Glass Company in Cumberland, Maryland. In 1891, they met in Cumberland to form their own corporation and subsequently purchased, for \$10,000, the plant of the Fostoria Glass Company, at Fostoria, Ohio (Fostoria Glass moving to Moundsville, West Virginia). [1] The new company flourished from the beginning but was soon faced with the threat of a fuel shortage. In 1896, the directors decided to relocate their plant near a plentiful supply of natural gas and decided upon Morgantown. The new plant began production in January 1897 and continues to be a successful operation up to the present.

Several factors contribute to the importance of the plant and to the interest which it stimulates among historians and casual observers. On a technological level, the plant itself still operates using essentially the same machinery and process with which it began over 80 years ago. The original furnace and factory still stand, although the total area of the latter has been greatly expanded by numerous additions. The glass is still produced from the original 14-pot furnace by "shops" or teams of men in much the same manner as it was in 1897. The persistence (with a remarkable degree of success) of technology which was developed in 1890 provides irresistible opportunity for speculation as to the nature and source of innovation in the industry. On an economic level, Seneca is significant because it was the first of many such companies which located in Morgantown during that city's period of industrial development. At the turn of the century, when transportation facilities were only crudely developed, the discovery of the nearby Mannington oil and gas field was of considerable importance in attracting new industries. In the 16 years following the move of Seneca, nine other glass plants located in Morgantown. These developments (along with that of the coal industry in the area) brought industrial processes with all their social and economic ramifications to what had been primarily an agricultural region. Finally, since the founders of the company were of German origin, Seneca's history sheds light on the position of immigrant labor in the glass industry.

The success of Seneca Glass illustrates the degree to which the American glass industry continued to be dependent on the skills of immigrant labor as late as the early years of this century. The records show that in this period, when nativism and resentment of immigrants reached a peak in American history, the apparent attractions and benefits of industry were sufficiently strong to overly such fears. [2]

It is not the intent of this paper to generalize on these and other issues from the single example of Seneca Glass Company, but rather to relate it to patterns which emerge from the history of the industry as a whole. Many of these patterns, however, are far from proven. In such cases, my generalizations are intended to stimulate further inquiry.

The glass industry in the United States is a product of the 19th century. As such, it is naturally connected with and dependent upon the growth and development of many other facets of American industrial activity. Glassmaking, after all, was centuries old and had reached a highly complex and sophisticated level in European countries even before Columbus. In fact, its long-established value was a deciding factor when the Virginia Company attempted to defray its losses at Jamestown by producing industrial goods for the mother country. [3] This venture and similar ones in New York, Pennsylvania, and Massachusetts failed, and no attempt was made to revive them for over a hundred years. In the 1770's, when she was seeking more economic independence from England, America encouraged the art and several new glasshouses were constructed. But it was not until after the Revolution, when the relationship between economic independence and political independence was clearly recognized, that the glass industry (and many others as well) became firmly established. During the next 100 years, from about 1790 to 1890, glass manufactories increased steadily in size and number to a point at which they held a respectable position among American industries. [4]

During this initial phase, the success of glassmaking depended more on social and economic factors than on technology. With a few exceptions, the technology of glassmaking during this period remained stable. It was essentially a medieval craft requiring a large number of skilled workmen, whose labor, along with the cost of fuel, made up a very large proportion of the market price of the product. These workmen served long apprenticeships, were highly organized, and closely guarded entrance into the trade and its secrets. In this respect, they thoroughly resisted the reduction of skills to literary form and the dissemination of this information into the public domain. [5] For this reason, the technology of glassmaking was, and continued to be in its initial American phase, highly resistant to change and very dependent on the traditional knowledge of the immigrant workers. For entrepreneurs interested in starting native glassworks, assembling a group of competent foreign workers was a difficult but necessary task. A brief sketch of the state of the art as it existed in the early 19th century adds perspective to the formation and subsequent history of the plant at Seneca.

The immigrant glassworker of 1820 brought with him knowledge and skill gained through experience with the various stages in the process of making glass: mixing of the ingredients (the "batch"), fritting (pre-heating the batch to drive off impurities), "fusing" (melting and driving off air pockets), "gathering" (taking the molten onto the

pontil or blowpipe), blowing, and finishing. All were difficult steps where a slight mistake might ruin the piece being made or even the whole batch. Before or about 1840, the master glassworker would usually participate in all of these stages and would rest only during the "melt," usually about 16 hours, and after the batch had been entirely used up. Furnaces in 1820 were much smaller and contained fewer and smaller pots. Those of English design were circular, 608 feet in diameter, while furnaces of German design were rectangular. Since the former were designed to use coal, they were not very common in America until after 1850. Both types were fired from the blowing-room floor and contained a grate through which the ashes fell into a pit in the basement. The pots themselves were made by the workers, who treaded the clay with their bare feet and coiled long ropes of it into a circular shape. This process took about three months and the subsequent drying from two months to a year. The size varied from about 20 inches (500 pounds capacity) to about 40 inches (1500 to 2000 pounds capacity). [6] When the pot was ready to be used, it was put into the pot-arch or pre-heating oven, where its temperature was raised near that of the furnace itself. It was then removed on a caisson whose tongue was manned by a dozen or more workers who wheeled the hot pot into place. Before 1850, the glass-blower performed all the steps in the working of the molten metal himself--from the gathering to the finishing and placing the object into the annealing ovens. As glass factories increased in size, especially after 1820, these various steps came to be performed by specialized workers, and the master glassworker confined his efforts to the blowing and forming of the ware. From 1840 to 1890, the increasing division of labor produced what came to be called the "shop" system, in which a team of workers, the "shop," performed the functions formerly handled by one worker.

The development of the shop system was greatly facilitated after 1850 by the discovery of new fuel sources which allowed for a large increase in the size of the average glasshouse. The adoption of coal-fired and then gas-fired furnaces led to the reduction of size restrictions formerly imposed by the prodigious fuel demands of wood-burning furnaces. [7] A larger and more constant supply of energy meant that the supply of molten "metal" was limited only by the capacity of the pots and that productivity was dependent only on the skills and speed of the workers. Consequently, specialization of function was the result of a natural attempt on the part of managers to produce more ware. This situation is well documented in contemporary records of labor-management relations, particularly the formation of a series of schedules which regulated the size and number of ware to be produced in a given period of time. In spite of worker resistance, the shop system meant that the daily output per worker continued to increase. [8]

During this period of development, the new fuels also resulted in the adoption and standardization of the circular or English-type furnace. With the plentiful supply of coal in the trans-Allegheny

region and the growing importance of Western Pennsylvania within the industry, the early rectangular furnace was gradually abandoned. When gas eventually replaced coal, the firebox was moved to the cellar to eliminate the hazards of stoking and to provide more space on the blowing-room floor. The efficiency of this organization appears to have been great, since the process resisted further change and has survived virtually intact until the present at Seneca Glass and a number of other plants in the area. During a period in which other branches of the industry were undergoing rapid change, blown glassware production, from a technological standpoint, was virtually unchanged. The factors which produced this state of affairs lie partially in the conditions which gave birth to such plants in Seneca.

Along with the division of labor in the individual glasshouse, a tendency toward specialization of the industry as a whole occurred. While in 1820 most plants produced a variety of ware and their workers had a variety of skills, by 1850 several distinct specialties had evolved. The largest and most important of these was that of window-glass manufacture. The nature of the market and the demand for this product was such that in early glassworks it made up the bulk of domestic production. Like tableware, it was blown by a skilled craftsman and finished by hand as it had been for centuries. Until the 1870's, the process for window-glass production was basically the same as that for tableware. The same was true of that branch of the industry which produced bottles and jars. Encouraged by the growth of the patent medicine and alcoholic beverage trade, the demand for bottles increased rapidly from the early part of the century. Gradually, companies were formed which produced only bottles in a dizzying array of shapes and sizes.

Finally, the development of flint glass led to an expansion of the tableware industry. From 1805 until about 1860, the output of pressed and blown flint went from practically nothing to over 80% of all domestic glass production. [9] One of the last branches of the American glass industry to develop, tableware was particularly sensitive to market fluctuations. Until about 1830, glass tableware was considered a luxury, and the difficulty of producing it had caused American companies to concentrate their efforts on window-glass and bottles, which demanded less skill and promised better markets. Consequently, the small market for fine tableware was supplied by imports, mainly English. From 1830, the development of domestic lead supplies for the production of flint ware, the rediscovery of pressing in glass manufacture, and an increasingly affluent population led to the establishment of this branch on a substantial scale.

The division of the glass industry into distinct window, container, and tableware branches set the stage, in 1870, for a revolution in the method of production. If we consider for a moment the striking contrast between the modest scale of a plant like Seneca Glass and the monumental proportions of present window and container glass companies like

Libby-Owens-Ford or PPG, the importance of this revolution becomes obvious. The former uses essentially the same technology with which it was founded, while the latter do not even vaguely resemble the plants of 1900. The separation of the industry into window-glass, bottles, and tableware and the steady growth in size of the average firm prior to 1870 provided the conditions for unparalleled innovation. Individual manufacturers were able to focus on a narrower range of products, constantly refining the organization of work within their plants. A constantly increasing demand, particularly for bottles, coupled with the traditional scarcity of workers and the already efficient shop system, implied that any increase in production could only come through mechanization. The increase in the size of the average firm indicates that the necessary capital was available for such experimentation and investment. In addition, the recent development of several key factors made this innovation inevitable. [10]

Probably the most influential of the innovations which facilitated the mechanization of window and bottle glass manufacture was the introduction of gas furnaces. The first attempt to use gas as a fuel was made in England in 1861. By 1881, 21 factories in the United States were using either natural gas or producer-gas made from coal. With gas, manufacturers could better control the temperature of the batch and assure the regularity of the glass--an important requirement for the introduction of the machine process, which required the glass to "set" or harden at regular intervals. [11]

A second innovation which proved important was the development of the continuous tank furnace. Made possible by the use of gas, this furnace was open at the top and the batch was heated from above by a series of gas jets. This arrangement allowed for the maintenance of a constant level within the tank by the replacement of raw materials at one end as the glass was taken up at the other. The eventual high cost of automation was justified by this development. With a continuous supply of metal, expensive new machinery could be kept in constant operation without the necessity of waiting hours for the batch to "fuse." [12]

Closely related to the development of the tank furnace was the development of lime glass in 1864 by William Leighton, Sr., of J. H. Hobbs, Brockmeyer and Co. of Wheeling, West Virginia. By substituting bicarbonate of soda for the expensive lead of flint glass, Leighton succeeded in developing a cheap, bright, crystalline glass. This new "lime" glass was an impetus to the adoption of continuous tank furnaces since, unlike lead glass, it was not ruined by the direct flame of the tanks. After 1864, lime glass gradually displaced flint in the production of all but the most delicate and expensive tableware.

In the wake of these improvements, the glass industry, from 1880 to 1920, experienced a dazzling series of inventions which transformed the production of containers and window glass from a handicraft to a

highly mechanized industry. In the window-glass branch, J. H. Lubbers patented in 1903 his mechanical cylinder glass blower, capable of drawing from an open tank cylinders 35 to 40 feet long and twice the diameter of those blown by hand. No sooner had Lubber's machine wreaked havoc among workers than Michael J. Owens and his associates at the Toledo Glass Company introduced the sheet drawing process in 1917 at their plant in Charleston, West Virginia. This technique of drawing flat sheets directly from a tank of molten metal eliminated the expense of cutting and flattening the cylinders. In the container industry, the 1890's witnessed the introduction of a varied array of semi-automatic bottle machines. These combined pressing and compressed air-blowing to eliminate the most skilled workers but still had to be "fed" by a gatherer. These "semiautomatics" were gradually adapted to other ware with mass market potential, especially lamp chimneys and common tumblers. [13]

In 1903, Owens patented his automatic bottle machine, which introduced a suction device to take up the molten metal, thereby eliminating the gatherer. The use of conveyor belts to take the finished ware to the annealing lehrs meant that the glass was not manipulated by human hands from the time the batch was mixed until the finished products were packed. [14] The 200 Owens machines in operation in 1917 were capable of producing more bottles than all the bottle blowers in the country had produced in 1905. [15] In short, the window-glass and container branches of the industry, which had provided employment for the overwhelming majority of glassworkers, experienced a complete mechanization from 1890 to 1920. Only with this fact in mind can we fully appreciate the subsequent history of the hand-blown tableware industry and the founding in 1891 of Seneca Glass Company.

One of the principal factors in the persistence of the hand-blown tableware industry was its use of lead glass. The use of lead in glass gave it qualities unmatched by even the finest lime ware. Lead gives the glass a softness and resilience which makes it particularly suitable for cutting in the many shapes and patterns of traditional crystalware. Its softness also means that it is less likely to shatter upon impact. Lead also imparts brilliance and a bell-like metallic tone when struck.

The production of lead glass is a particularly difficult feat calling for extreme care in purifying and measuring the raw materials and in controlling the temperature and duration of the melt. The subsequent cutting of fine crystal requires years of experience to master, and each piece takes hours of painstaking work to complete. Finally, lead glass production has successfully resisted mechanization because the metal cannot be produced in open tanks but must be made in closed pots. For these reasons, the lead glass industry after 1890 depended on a small but elite market willing to pay a premium for such expensive ware. Success in this small sector of the industry depended upon the sensitivity of the company to elements of design and the shift of public

tastes rather than economy of production.

The founding of Seneca Glass is an example of the readjustment of skilled glassworkers to the process of specialization and mechanization which the industry underwent during this period. Skilled workers intent on continuing the practice of their traditional craft were forced to concentrate their efforts in areas most resistant to automation. Large hotels and restaurants, steamship lines, and wealthy individuals still provided a small but appreciative market for fine tableware. A company like Seneca could concentrate on this market and succeed by paying minute attention to the delicate processes involved and by promoting its product in magazines and journals which reached this class of consumers. [16] In such a market, the advantages of machine production were minimized by the number and variety of small lot ware. [17] Hence, skilled craftsmen faced with the specter of mechanization had three alternatives. They could remain where they were and become machine operatives; they could abandon glasswork altogether; or they could attempt to gain employment producing specialty items.

To many today, looking back on the period with a feeling of nostalgia for the vanished era of hand production, such a situation seems somewhat tragic. A close look, however, reveals that the subsequent reorganization of the glass industry in the wake of mechanization, if not a positive step, was at least a mixed blessing. In the first place, mechanization led to the expansion of the industry as a whole--stimulating the demand for glass as a greater portion of the population could afford the cheaper products. Second, mechanization occurred in those branches where skill was least important, tending to focus naturally on ware whose distinguishing aspect of production was already repetition (bottles, for example). Finally, since the production of specialty items such as fine tableware was limited, those workers who met with success in this area were often the most skilled and imaginative. Hence, the period in which Seneca was established and of which it was one of the outstanding examples was the beginning of a "golden age" of American lead crystal. The same economic and social forces which made possible the mechanization of a large part of the industry firmly established the manufacture of a high-quality ware of artistic merit. That is to say, the general industrialization and economic growth after the Civil War created a mass market for certain machine-made glass products and an elite market for hand-made ware. The latter was not unlimited, however, and the success of such firms as Seneca depended on the technical, aesthetic, and managerial skills of its organizers.

Although the technique employed to produce glass at Seneca is centuries old, the plant itself is in many ways an artifact of the 1890's. Although the shape of its furnace is derived from the English type of the late 17th century, its size was made possible by the introduction of gas as a fuel. Its pots are much larger than the typical 1840 pot. In the cutting shop, the grinding wheels are now powered by

electric motors, but the remnants of a system of belts and pulleys driven from a central source of power still hang from the beams in typical 19th-century fashion. The original corrugated shed siding of the furnace room has only recently been replaced by a more modern version.

Today, even a casual observer of the glass production at Seneca would hesitate to label it as a handicraft process. The existence of the "shop" structure in the blowing room is only the most obvious example of Seneca's industrial organization of work. The high degree of specialization extends to the finishing, cutting, and packing departments as well. In the cutting shop, for example, specialized workers perform a single step in the process of turning the plain ware into elaborately cut crystal. Using a grease pencil, one worker draws symmetrical lines on each glass to guide the cutter. The cutters are divided, each making only the cuts determined by the size of his cutting wheel. Though most are capable of cutting the entire design, this assembly-line organization increases the speed and efficiency of production. This system is a far cry from the handicraft organization in which each worker has a major responsibility for the final product. In fact, if market conditions were developed to the point where mechanization becomes economically feasible, Seneca might someday be considered as a transitional phase in tableware production.

The role played by Seneca Glass in the industrial history of Morgantown provides valuable insights into the process of industrialization as a whole in the late 19th century. The location of Seneca and other glass plants in the area was due partly to a concerted effort by civic leaders to develop the industrial potential of the area. The Morgantown Building and Investment Association offered Seneca inducements of free land, a low rate on gas, and \$20,000 with which to build their factory, in hopes that a general trend of industrialization might result. The effort was partially successful. In the next 16 years, nine other glass factories located in Morgantown. [18]

From 1890 to 1920, Morgantown experienced its first and only period of industrial growth. In the case of the glass factories, this growth was caused by the recent discoveries of nearby sources of gas and oil. But the development of local deposits of coal stimulated a broader range of activities. In addition to influencing the formation of companies which performed a supportive role in mining (machinery and equipment), cheap local coal resulted in the expansion and mechanization of hand industries such as sawmills and gristmills, woodworking, and those which used a process where steam power was feasible. Coal and oil proved to be an impetus to the further development of transportation facilities in Morgantown. The increased freight justified the construction of the Morgantown and Kingwood Railroad Shops (1899) and several small foundries for the repair of steam machinery. [19]

The impact on Morgantown of rapid population growth and new industrial conditions of labor has never been thoroughly examined. Just how they affected the social and institutional structure of Morgantown is unknown. Although Morgantown had undergone commercial development from 1860 to 1890, in 1890 it was still a sleepy river community of about 1,000 people. From 1900 to 1910, its population increased from 2,000 to 10,000. Many of these new inhabitants were in glassmaking and mining. The nine glass plants alone, in 1913, employed approximately 1,800 persons, or almost 20% of the total population. [20] Since most glassworkers were skilled craftsmen, few of these plants drew from local labor. Like the founders of Seneca, most came from older glass-producing areas in Pennsylvania, Ohio, Maryland, and New Jersey; some came from overseas. The reception received by these newcomers and the role they played in subsequent civic affairs has gone largely unrecorded.

Some insight into the impact of these developments can be had from an examination of the subsequent industrial history of Morgantown. From 1920 to about 1945, the city went through a period of industrial stagnation. The general industrial and economic development envisioned in 1895 by the organizers of the Morgantown Building and Investment Association never materialized. Although the glass industry continued to prosper, it did not foster a climate of general expansion. As transportation facilities improved, coal, gas, and oil were shipped to distant manufacturing centers. It became increasingly evident that the existence of natural resources was no longer sufficient to promote industrialization. Rather, the process was dependent on a combination of factors, including those of financial resources, entrepreneurial leadership, and a pool of plentiful labor. Finally, one wonders to what extent the course of industrial development depends on the existence of a favorable psychological climate rather than a material one. Perhaps, in the case of Morgantown, the rate of progress has been too rapid for the population to adjust to it.

The relative importance of these factors and the impact of industrialization on the social structure of the city remain to be explored. One thing is certain: whatever its effects, the character of industrialization in Morgantown was intimately connected to and determined by the particular form which it assumed in the local glass industry. Its heavy dependence on skilled labor, the strong union organization, the limited opportunities for mechanization of lead glass production, and a small, erratic market all determined the nature of Morgantown's particular experience with industrialization. The question of the role of this experience in the city's subsequent industrial history remains unanswered largely because local historians have never addressed it.

There is evidence that ethnic consciousness played a definite, if covert, role in the formation and operation of many 19th-century glassworks. In Europe, a constant demand for glass and the prestige traditionally accorded to skilled glassworkers meant that labor

recruitment was highly nepotistic, sons and nephew continuing their elders' trade. Although difficult to document on an extensive scale, it would be highly surprising if such practices did not carry over in America. It is also likely that nepotism coupled with the traditional secrecy of the industry would be, and in some cases was, considered by native Americans as examples of ethnic prejudice. The success of early American glass entrepreneurs like Caspar Wistor, John Frederick Amelang, and Henry William Stiegel indicates that being of the same cultural background as his workers did not hurt the owner of a glassworks. "Baron" Stiegel, for example, knew little about glass when he erected his works in 1764 in Manheim, Pennsylvania. Manheim itself was founded by Stiegel in the heart of "Pennsylvania Dutch" country, probably to attract skilled German artisans. [21]

A hint of the resentment of native Americans toward such practices is revealed in Deming Jarvis's Reminiscences of the Glass Industry. Jarvis was a native American glass entrepreneur who achieved considerable fame as head of the early New England Glass Company. More important, his book is one of the few personal accounts of the early history of the industry. While he notes the individual successes of some, Jarvis generally neglects the achievements of German glassworkers, preferring to focus on the English and Americans who controlled the manufacture of glass in the Northeast. At one point, he denounces the

great evil (which has too usually prevailed among the imported workmen) of a determination to prevent the instruction of apprentices by the most arbitrary and unjust means and, so far, as it was in their power, endeavoring to prevent competition, by not only controlling the hours of work, but the quantity of manufacture; in fact, doing the least amount of work possible for the largest amount of pay that could be coerced from the proprietors. [22]

Jarvis's complaint is not merely a management-labor conflict. Similarly, his frequent denunciation of secrecy suggests a desire to eliminate the oral character of the glass trade and replace it with a literary vehicle. In this sense, his book is a step in that direction. He traces the history of glassmaking, offers tips on the construction and management of furnaces, recipes for various kinds of ware, and advice on the economics of production and distribution. All these have the effect of removing the aura of mystery and make the manufacture of glass comprehensible. This, of course, would reduce the importance of group solidarity in the area of technology and increase the importance of management and marketing as criteria for economic success. In effect, it would tend to separate technology from culture--European culture in particular--and to make the manufacture of glass accessible to native Americans. In retrospect, we can see that Jarvis's wish has ultimately been fulfilled. The glass industry has abandoned its oral character.

The proliferation of trade journals and professional societies has given it a more "scientific" (to use Jarvis's term) basis. All plants, for example, today employ chemists to mix and test their batch.

Yet it would be wrong to give Deming Jarvis the credit for this turn of events. Rather, the most important factor might be the cross-cultural experience itself. The operation of this process may be observed in microcosm in the later development of Seneca Glass.

Although the company retained its intimate, familial character, Seneca gradually came to resemble a more typically American organization. In the second generation, its directors were themselves no longer glassworkers but professional managers. [23] Executive decisions were made more in response to July 1973 market conditions than to conditions of work. On their part, workers began to stress their identification with the union rather than the company. The family traditions of glassworking broke down as second and third generation immigrants lost their old cultural identity and moved readily into the mainstream culture. [24] Today, although Seneca employs a basic process that is centuries old, it is in the process of becoming a typically American institution.

Footnotes

1. Minutes of Meetings of Board of Directors, Seneca Glass, p. 2 (August 10, 1891).
2. John Higham, Strangers in the Land [].
3. Pearce Davis, The Development of the American Glass Industry (New York, 1949), p. 23.
4. Davis, p. 96.
5. Deming Jarvis, Reminiscences of Glass-Making, 2nd ed. (New York, 1865), pp. 43-52.
6. Davis, pp. 45-46.
7. Davis, p. 76.
8. Warren Scoville, Revolution in Glassmaking (Cambridge, Massachusetts, 1948), p. 22.
9. Davis, pp. 63, 71.
10. Scoville, chs. 1-3.
11. Scoville, p. 177.
12. Scoville, p. 176.
13. Davis, pp. 205-206.
14. Davis, p. 209.
15. George E. Barnett, Chapters on Machinery and Labor (Cambridge, Massachusetts, 1928), pp. 88-89.
16. Felix Robinson, "Seneca in Its Sixty-Seventh Year," Tableland Trails, Vol. 2, No. 3 (1959), pp. 95-96.
17. Davis, pp. 236-237.
18. West Virginia Geological Survey, County Reports, Vol. 7 (Wheeling, 1913), p. 17.
19. Callahan, History of West Virginia, p. 463.
20. West Virginia Geological Survey Reports, pp. 17-22.

21. George L. Heiges, Henry W. Stiegel and His Associates (Lancaster, Pennsylvania: 1948), pp. 47-48.
22. Jarvis, pp. 69-70.
23. Interview with Harry Kammerer, Vice-President, Seneca Glass Co.
24. Taped interviews with Ralph Rousseau and Victor Rancinger, July 1973.

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